

ary artery disease may have a normal response, but it is clear that this test is considerably more sensitive than standard ECG treadmill testing for the detection of hemodynamically significant coronary artery disease.

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Radionuclide Bone Imaging in Stress Fractures

WITH THE PRESENT INTEREST in physical fitness the incidence of stress fractures has increased. Pain, heat and swelling may occur acutely, or insidiously, without a direct association with stress. The differential diagnosis may include cellulitis, thrombophlebitis, tendonitis, malignancy, inflammation, soft tissue injury hematoma, osteosarcoma or osteomyelitis. Radiographic diagnosis may be difficult. Bone images, which reflect osteoblastic activity and blood flow, are useful in these instances, as well as in fractures of radiographically difficult bones, such as ribs, metacarpals, carpals, metatarsals, tarsals, and skull and scapula.

Stress fractures start with bone resorption during the 48 to 72 hours after stress, followed by bone remodeling, which lasts two to three weeks. When resorption is greater than replacement, the cortex is weakened and fractures may result. They are common in the femoral neck (where they may progress to an overt fracture with displacement), the tibia (usually the plateau), metatarsals, os calcis, distal femoral diaphysis and pubic rami. The treatment is rest.

A standard bone image is obtained: 10 mCi of technetium 99m diphosphonate, or a similar agent, is given intravenously. Imaging is done one to three hours later. In acute injuries the image may be negative for 24 to 48 hours, while there is vasoconstriction and discontinuity of osseous circulation. However, in one study findings were positive in 24 of 28 stress fractures during the first 24 hours. These early abnormal findings are seen in young patients, in incomplete or well-approximated fractures and in smaller bones. The

abnormal image is delayed in elderly patients, if there is poor approximation or immobilization, and where there is a compromised blood supply, previous irradiation or an underlying bone abnormality such as osteoporosis.

Radionuclide images may be positive before an actual fracture occurs, explaining the observation that in patients with positive tibial plateau images who were given rest, abnormal findings never occurred on radiographs.

Bone images are useful in the diagnosis of occult fractures or those occurring in bones that are difficult to diagnose radiographically.

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Emergency Nuclear Medicine Procedures

TO MEET THE DEMAND for emergency nuclear medicine procedures, those studies whose results have an immediate effect on the patient's care have increased significantly in many laboratories. The immediate availability of technetium 99m labeled agents and improved and portable imaging cameras help provide needed information rapidly.

About half of the emergency procedures are lung perfusion studies to rule out pulmonary embolism. Abnormal studies may be further evaluated by ventilation or aerosol imaging or by angiography. A normal perfusion scan done in at least four views virtually rules out pulmonary emboli.

About 25 percent of emergency procedures are liver-spleen studies for abdominal trauma associated with a falling hematocrit, where ruptured or lacerated organs are suspected. Four or five spleen views are necessary to look for filling defects or irregular margins. In doubtful cases repeat studies may show persistence, enlargement or disappearance of the defect. Standard liver studies are also done to rule out amebic or purulent abscesses.

Occult abscesses may be evident on a four-hour gallium-67 study. In questionable cases, a 24-hour or 48-hour image must be obtained. Pneumonias may be evident as a region of increased uptake even before an x-ray study of the chest shows abnormalities.

Other emergency nuclear studies include static brain imaging to rule out abscesses or other space occupying lesions before spinal tap. Possible kidney trauma may be evaluated by technetium 99m glucoheptonate imaging on an emergency basis. Bone scanning may be helpful to evaluate the hips for possible infection because failure to recognize and institute surgical draining may result in necrosis of the femoral head.

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Iodine 125 Fibrinogen Uptake Test

THROMBOPHLEBITIS occurs in several million persons every year in the United States and emboli occur in 10 percent of these persons. Although more likely to occur in patients in hospital, thromboembolic disease also occurs in otherwise healthy persons. Less than 50 percent of patients with thrombophlebitis have significant clinical manifestations, and in only 35 percent of patients is a presumptive diagnosis of thrombophlebitis corroborated by diagnostic procedures. Diagnostic advances have led to a better understanding of this disease and to improved methods for its diagnosis. Although radiopaque venography is at present the "gold standard," it is not suitable for screening because of its complexity, invasiveness and risk of induction of thrombophlebitis (5 percent to 15 percent). Standard laboratory blood tests are inadequate although newer radioimmunoassays have substantial promise. Radiopaque venography shows four cardinal signs of thrombophlebitis: (1) constant filling defects, (2) abrupt termination of the contrast column, (3) nonfilling of the entire deep venous system or portions thereof and (4) diversion of flow into collateral veins.

The ^{125}I fibrinogen uptake test, now generally available in the United States, is suitable for

general screening purposes, and a diagnosis can be confirmed within four to 24 hours after administration of the radiopharmaceutical. When homologous fibrinogen is labeled with radioactive iodine and injected, it behaves like the patient's own fibrinogen. When a thrombus forms, fibrin, including some of the labeled fibrinogen is deposited, so that the thrombus will have a higher concentration of radioactivity than the surrounding areas. The ^{125}I fibrinogen uptake test is only positive when fibrin is actively deposited; therefore old or well established thrombi may be missed. In practice, this has not proven to be a major problem; experimental evidence suggests there is dynamic exchange of fibrinogen between the blood and established thrombi. Emissions from the radioactive iodine are detected by external counting over the veins; a clot is localized by radioactive counts in excess of background counts of tagged fibrinogen in the circulating blood. Counts may be taken at the bedside by a technician using a lightweight, hand-held scintillation detector. The legs are counted in segments extending from the inguinal ligament and following the course of the femoral vein to the posterior aspect of the knee, then to a point just posterior to the internal malleolus of the ankle. Counts are done once or twice on the day of injection and daily thereafter until the test becomes positive. If there are indications of a thrombus, then counting can be continued to observe whether the thrombus is extending or dissolving, or to assess the effect of therapy. A difference in uptake when compared with (1) the same site on the opposite leg or (2) adjacent sites or (3) earlier uptake over the same site is interpreted as evidence of thrombophlebitis.

Clinical studies have documented the efficacy of the ^{125}I fibrinogen uptake test for diagnostic use in patients with established thrombophlebitis, as well as for prospective use in patients in whom there is risk of thrombophlebitis developing. The test is positive in two thirds of patients with existing thrombophlebitis by 3 to 4 hours and in almost all others by 24 hours after injection of the fibrinogen. There are virtually no adverse effects. When compared with radiopaque venography, it has a sensitivity of 90 percent and a similar specificity if certain well-defined conditions are considered. Other inflammatory diseases may also cause a positive result. It is particularly important to search for conditions (ulcers, hema-